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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/896,363	06/28/2001	Hong-Qiang Lu	LSI1P167/01-206	2235

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EXAMINER
TOLEDO, FERNANDO L

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 06/02/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/896,363	LU ET AL.	
	Examiner	Art Unit	
	Fernando Toledo	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 February 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) *15-20* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6,8,10 and 14* is/are rejected.

7)☒ Claim(s) *7,9 and 11-13* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 June 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 8, 10 and 14 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claims 8, 10 and 14 have the following limitation: the carbide layer is formed by injecting $SiH_x(CH_3)_y$ gas, where x is chosen in the range of 1 to 4, and x+y=4. However, this is indefinite since if x = 4, then the injecting gas will be SiH_4 and it cannot possibly form SiC by itself. Note that this mistake can also be found in the specification on page 8 lines 13 – 15.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

4. Claims 8, 10 and 14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

5. In re claims 8, 10 and 14; how can SiC be formed by injecting only SiH_4? Is there another gas being injected? If so, which one?

Claim Objections

6. In re claim 7, discloses the following limitation: "patterning the photoresist layer to form a photoresist mask over a dielectric layer where a via is to be formed." Is this a third dielectric layer? Examiner assumes that this dielectric layer is actually the second low-k dielectric layer. If Applicant disagrees with the assumption made by the Examiner, Applicant is encouraged to clarify the assumption.

7. Claims 7, 9 and 11 – 13 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 1 – 3 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chung, Wei-Ming (US 2002/0106895 A1) in view of Tsai et al. US 2003/0077897 A1 and Sundrarajan et al. (US 2002/0027286 A1).

In re claim 1, Chung in the United States Patent Application Publication US 2002/0106895 A1; figures 1 – 5H discloses depositing a first barrier layer 502 on a surface located to control electrical leakage from a conductor; depositing a nitrogen-free second barrier layer 504 on top of the first barrier layer; forming a first dielectric layer

505 over the second barrier layer; and depositing a photoresist material to form a photoresist layer 507 above at least a portion of the first dielectric layer.

Chung does not teach wherein the dielectric layer is a low-k dielectric layer and wherein the first barrier layer is a silicon carbonitride layer.

Tsai in the United States Patent Application Publication US 2003/00777897 A1; figures 1a – 2i discloses that low-k dielectric such as FLARE and SiLK provides an additional barrier layer but also a smooth surface for good adhesion (paragraph 0035).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to form a FLARE or SiLK low-k dielectric layer in the invention of Chung, since as taught by Tsai, the low-k dielectric layers provide an additional barrier layer and a smooth surface for good adhesion.

Chung in view of Tsai does not disclose wherein the first barrier layer is a silicon carbonitride layer.

However, Sundrarajan discloses that SiCN (i.e. silicon carbonitride) has low leakage current and is effective in preventing the migration or diffusion of metal or copper atoms through the SiCN layer (abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the first barrier layer of Chung with a SiCN layer, since it has low leakage current and is effective in preventing the migration or diffusion of metal or copper atoms through the SiCN layer.

10. In re claim 2, Chung discloses patterning and etching the photoresist layer to form a photoresist mask (Figure 5B).

11. In re claim 3, Chung teaches wherein depositing a nitrogen-free second barrier layer on top of the first barrier layer includes depositing a nitrogen-free silicon carbide layer (paragraph 0005).

12. In re claim 5, Chung in view of Sundrarajan discloses wherein depositing a first barrier layer containing silicon carbide and nitrogen includes using a PECVD process and on of NH_3, N_2, and N_2O as a chemical precursor to supply the nitrogen (abstract of Sundrarajan).

13. Claims 4 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chung, Tsai and Sundrarajan as applied to claims 1 – 3 and 5 above, and further in view of Law et al. (U. S. patent 6,338,874 B1).

In re claim 4, Chung in view of Tsai and Sundrarajan do not disclose wherein the process tool used to deposit the first barrier layer is used to deposit the nitrogen-free barrier layer.

However, Law in the U. S. patent 6,338,874 B1; figures 1 and 2 and related text, discloses this process (i.e. one chamber process) eliminates one or more transfers of the large substrates between reaction chambers (Column 2, Lines 10 – 12).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the two barrier layers of Chung in view of Tsai and Sundrarajan in the same chamber, since, as taught by Law, it eliminates one or more transfers of the large substrates between reaction chambers.

14. In re claim 6, Chung in view of Tsai, Sundrarajan and Law discloses wherein depositing a nitrogen-free second barrier layer includes the PECVD process recited in claim 5 and turning off the supply of nitrogen.

Allowable Subject Matter

15. The following is a statement of reasons for the indication of allowable subject matter: Claims 7, 9 and 12 would be allowable since Chung, Sundrarajan, Tsai and Law do not disclose, teach or suggest, forming an etch stop layer on top of the second barrier layer and forming a second low-k dielectric on top of the etch stop layer. Chung in view of Sundrarajan, Tsai and Law discloses forming the etch stop layer on top of the first low-k dielectric layer and forming the photoresist on top of the etch-stop layer. Chung in view of Sundrarajan, Tsai and Law also use the second barrier layer as an etch-stop layer, making the use of an additional etch-stop layer unnecessary. Therefore the claimed invention as a whole is neither anticipated nor rendered obvious over the prior art of record.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fernando Toledo whose telephone number is 703-305-0567. The examiner can normally be reached on Mon-Fri 8am to 4pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers

for the organization where this application or proceeding is assigned are 703-308-7382 for regular communications and 703-308-7382 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

George Fourson
Primary Examiner
Art Unit 2823

FToledo
May 28, 2003